Overview

• First Day Details (web pages)
• Opportunities
• Introduction to Computers
• Checking out & Building Robots
First Day Details

See course webpages.
Opportunities for Students in Technology-Related Majors

- Computer Science & Mathematics Mentorship & Scholarship Program
- Internships (On-Campus & Industry)
- Research Assistantships
Computer Science & Mathematics Mentorship & Scholarship Program

- Provides scholarships, a laptop, mentoring and career planning
- Majoring in technology-related field
- Good grades in first year courses
- US Citizen or permanent resident

Funded by the National Science Foundation.
Internships (On-Campus & Industry)

Some recent internships:

- ABC Television
- Einstein School of Medicine
- FAA– La Guardia
- IBM Research
- NYC MTA
- National Medical Library
- New York Public Library
# Research Assistantships

A few examples:

<table>
<thead>
<tr>
<th>Computational Biology: Tree of Life Project</th>
<th>Wildebeest Cluster (132 processors)</th>
<th>Morphometrics with AMNH</th>
</tr>
</thead>
</table>

Katherine St. John  
City University of New York
Introduction to Computers & Robots

- What is a computer?
- What is a program?
- Compiling Programs
What is a computer?

A basic computer has a

- central processing unit (CPU) or “brain”,
- registers to keep track of next instruction & where data is stored.
- Two kinds of memory:
  - Read Only Memory (ROM): Often contains directions that programs the CPU and can’t be erased,
  - Random Access Memory (RAM): Used to store firmware and programs the computer runs.
What is a computer?

There’s also input devices:

• keyboard, mouse, scanner,...

and output devices:

• screen, printer, speaker,...
Lego Mindstorm Robot

The lego robot has:
• 8-bit CPU (in bulkly lego block, called the RCX)
• 16K Internal ROM & 32K static RAM (6K for programs)
• Input Devices: 2 touch sensors, 1 light sensor, I/R port
• Output Devices: 2 motors, screen, speaker, I/R port
Lego Mindstorm Internals

(Pictures of RCX internals from: http://graphics.stanford.edu/ kekoa/rcx/)
CPU Directions

• Most CPUs understand directions written in machine language—strings of 0’s and 1’s

• Each instruction corresponds to an “operation code” or opcode that consists of commands like: ‘‘Increment value in register AX’’

• Very hard to write program in machine language.

• Most programs are written in a high level language, like Java, Visual Basic, C or C++.
Programming

• The general process is:
  You write a program that looks like English (with lots of rules) ⇒ Gives a binary file “compiling” the computer can understand ⇒ You “run” the binary to execute the program

• A program is a set of instructions for the computer to follow.

• Programs implement algorithms—step-by-step directions for performing a task (ex: a recipe to make cookies, directions to make the robot turn $360^\circ$).
Not Quite C

• For the robot, we’re going to write programs in a variant of C, called Not Quite C (NQC).
• Legos come with a language called RCX– it’s very simple, but doesn’t allow you to do a lot.
• By using NQC, you can do more sophisticated programs and it will help you learn C/C++ and Java.
A Simple Program

// tankbot1.nqc – drive straight ahead

#define LEFT OUT_A
#define RIGHT OUT_C

task main()
{
    On(LEFT+RIGHT);
    until(false);
}

Katherine St. John
City University of New York
## Some Useful NQC Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>On(outputs)</td>
<td>turn on outputs</td>
<td>On(LEFT+RIGHT);</td>
</tr>
<tr>
<td>Off(outputs)</td>
<td>turn off outputs</td>
<td>Off(LEFT+RIGHT);</td>
</tr>
<tr>
<td>Fwd(outputs)</td>
<td>sets to forward direction</td>
<td>Fwd(LEFT);</td>
</tr>
<tr>
<td>Rev(outputs)</td>
<td>sets to reverse direction</td>
<td>Rev(RIGHT);</td>
</tr>
<tr>
<td>Wait(time)</td>
<td>wait for time (\frac{\text{time}}{100}) seconds</td>
<td>Wait(100);</td>
</tr>
</tbody>
</table>

(Much more on this in the next two lectures.)
Checking Out & Building Robots

- Robots are stored in Gillet 137.
- After a short break, need a few volunteers to help transport them to our classroom.
Checking Out & Building Robots

Each student will get:

- Large blue box of Lego pieces
- Small plastic shoebox to store assembled robot
- Labels to place on the robot RCX, the blue box, and the shoebox.
Checking Out & Building Robots

• Everyone will put a robot together and test the 5 built-in programs, described in the Lego instruction manual.

• The easiest robot (tankbot) to build is described in Chapter 5 of Dave Baum’s book. Subsequent chapters describe an easy bumper (bumpbot) and light sensor mount (linebot).

• We will begin cleaning up at 11:30am and must be completely out of the room by 11:50am.

• If you do not finish today, you may come during my office hours (W 11:30-12:30, Th 10-12) or when Gillet 137 suite is open (most T,W,Th 2-5).